

THE ANT LARVAE OF THE MYRMICINE TRIBE MYRMICINI¹

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The tribe Myrmicini comprises four genera: the New World *Pogonomyrmex*, with some three dozen species; the rare Ethiopian *Cratomyrmex* (which may not even belong in this tribe), with only two species; the common Holarctic (and also Indomalayan) *Myrmica*, with about 30 species; and the Holarctic *Manica* with half a dozen species.

This tribe is interesting partly because it includes harvesters (*Pogonomyrmex* and *Cratomyrmex*), but chiefly because it is the most primitive tribe of the subfamily Myrmicinae. (Wheeler, Bull. Mus. Nat. Hist. 45:660. 1922). Wheeler (*ibid.*, p. 24) regarded *Hylomyrma* as the most primitive genus in the tribe, with *Pogonomyrmex* next. Emery (Genera Insectorum, 1921-22), however, placed the Metaponini first, the Pseudomyrmini second and the Myrmicini third; within the Myrmicini he put *Myrmica* first, *Cratomyrmex* second and *Pogonomyrmex* third; *Hylomyrma* is treated as a subgenus of *Pogonomyrmex*. Our studies on the larvae support Wheeler's arrangement of *Pogonomyrmex* and *Myrmica*. *Pogonomyrmex* larvae are certainly more primitive than *Myrmica* larvae, as is evidenced by the following characters: the lack of anchor-tipped hairs on the abdomen; spinules on the posterior surface of the labrum coarse and isolated; mandibles stouter, with two large coarse mesal teeth and without mesal blade or concavity.

In this article we have described the larvae of three species of *Pogonomyrmex* and eight species of *Myrmica*. References from the literature are cited for one other genus and five additional species making a total of three genera and sixteen species considered.

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Tribe MYRMICINI (F. Smith)

Stout; diameter greatest at the fourth or fifth abdominal somite; slightly attenuated anteriorly; thorax very stout (when mature) and arched or bent ventrally, but not differentiated into a neck; posterior end broadly rounded. Antennae each with three (rarely two or four) sensilla, each of which bears a stout spinule. Head hairs short to long; mostly denticulate. Labrum small and short; breadth twice the length; bilobed; anterior surface of each lobe with 2-5 minute hairs and 1-5 sensilla; posterior surface spinulose and with 8-18 sensilla. Mandibles rather small or moderate-sized (ratio of head width to mandible length 2.1-2.9, average 2.5); stout (ratio of length to width at base 1.8-2.4, average 2.1); heavily sclerotized; no spinules. Apex of maxilla usually spinulose; palp and galea paxilliform, bearing respectively five and two sensilla; palp slightly shorter than or equal to galea. Anterior surface of labium usually spinulose; palp a low elevation bearing four or five sensilla; opening of sericteries a short transverse slit (concealed in a groove). Hypopharynx usually sparsely spinulose, the spinules minute and generally in transverse rows.

Genus *Pogonomyrmex* Mayr

Stout; diameter greatest at the fourth or fifth abdominal somite; slightly attenuated anteriorly; thorax very stout (when mature) and arched or bent ventrally, but not differentiated into a neck; posterior end broadly rounded; anus terminal or subterminal. Body hairs moderately numerous; mostly denticulate; anchor-tipped hairs lacking. Antennae each with three sensilla, each of which bears a stout spinule. Head hairs short to long; sparsely denticulate on the distal half. Labrum small and short; breadth twice the length; bilobed; anterior surface of each lobe with two or three minute hairs and 3-5 sensilla; ventral border of each lobe spinulose and bearing two contiguous sensilla; posterior surface with a few coarse spinules and numerous sensilla. Mandibles with the apex forming a rather long and moderately slender tooth which is round-pointed and which tapers slightly.

Wheeler & Bailey, 1920, p. 251: "Certain agricultural

ants, which feed on seeds (*Pogonomyrmex*, *Messor*) also nourish their young with the same food."

Wheeler (1928, p. 202) stated that the larvae of this genus are fed with fragments of seeds, but the very youngest larvae are fed on regurgitated food. (=1926, p. 243.)

Pogonomyrmex barbatus (F. Smith)

(Pl. 11, figs. 14-22)

Stout; diameter greatest at the fifth abdominal somite, slightly attenuated anteriorly; thorax very stout and arched ventrally but not differentiated into a neck; posterior end broadly rounded. Anus subterminal. Leg, wing and gonopod vestiges present. Nine differentiated somites. Integument sparsely spinulose on the ventral surface of mesothorax, metathorax and anterior abdominal somites and on the dorsal surface of the last few abdominal somites. Body hairs moderately numerous and rather uniformly distributed; with the distal half finely denticulate. Of two types: (1) short (0.05-0.12 mm), uniformly distributed; (2) long (0.31-0.42 mm), moderately abundant on the ventral surface of the thorax, elsewhere reduced to a single row around the middle of each somite. Cranium subcircular in anterior view, but with the genal outlines somewhat flattened. Antennae small slightly raised discs each with three sensilla, each of which bears a moderately long sharp spinule. Head hairs numerous, short to long (0.045-0.14 mm), with the distal half sparsely denticulate. Labrum small and short (breadth 2X length), bilobed, not narrowed ventrally; anterior surface of each lobe with two minute hairs, five isolated sensilla and a few minute spinules; ventral border of each lobe with two sets of two contiguous sensilla and a few spinules; posterior surface of each lobe with two contiguous and about five scattered sensilla, sparsely spinulose, the spinules coarse and isolated or in short rows. Mandibles robust and heavily sclerotized; apical tooth moderately long, moderately slender, tapering only slightly to a round point; medial teeth short, robust and round-pointed, the proximal curved medially and posteriorly, the distal pointed anteroventrally. Maxillae with the apex conoidal and spinulose, the spinules minute and isolated or in short rows; palp paxilliform with

four apical and one lateral sensilla; galea paxilliform with two apical sensilla. Labium with the anterior surface spinulose, the spinules minute and isolated or in short transverse rows; palp a short protuberance with five apical sensilla; opening of sericteries a short transverse slit (concealed in a groove). Hypopharynx sparsely spinulose, the spinules minute and in short subtransverse rows. (Material studied: numerous larvae from Texas.)

Forel, 1921, Fig. 1B on p. 23; larva in side view (after Wheeler). (=1928, Vol. I, Fig. 1B.)

Wheeler, 1900: "Still another modification of the 'poils d'accrochages' is seen in *Pogonomyrmex barbatus*, the young larvae of which have the longer bristles serrate on the apical half, so that they remind one of the hairs of certain mammals" (p. 21). Fig. 9a, nearly mature larva; b, young larva; c, hair of latter (p. 20).

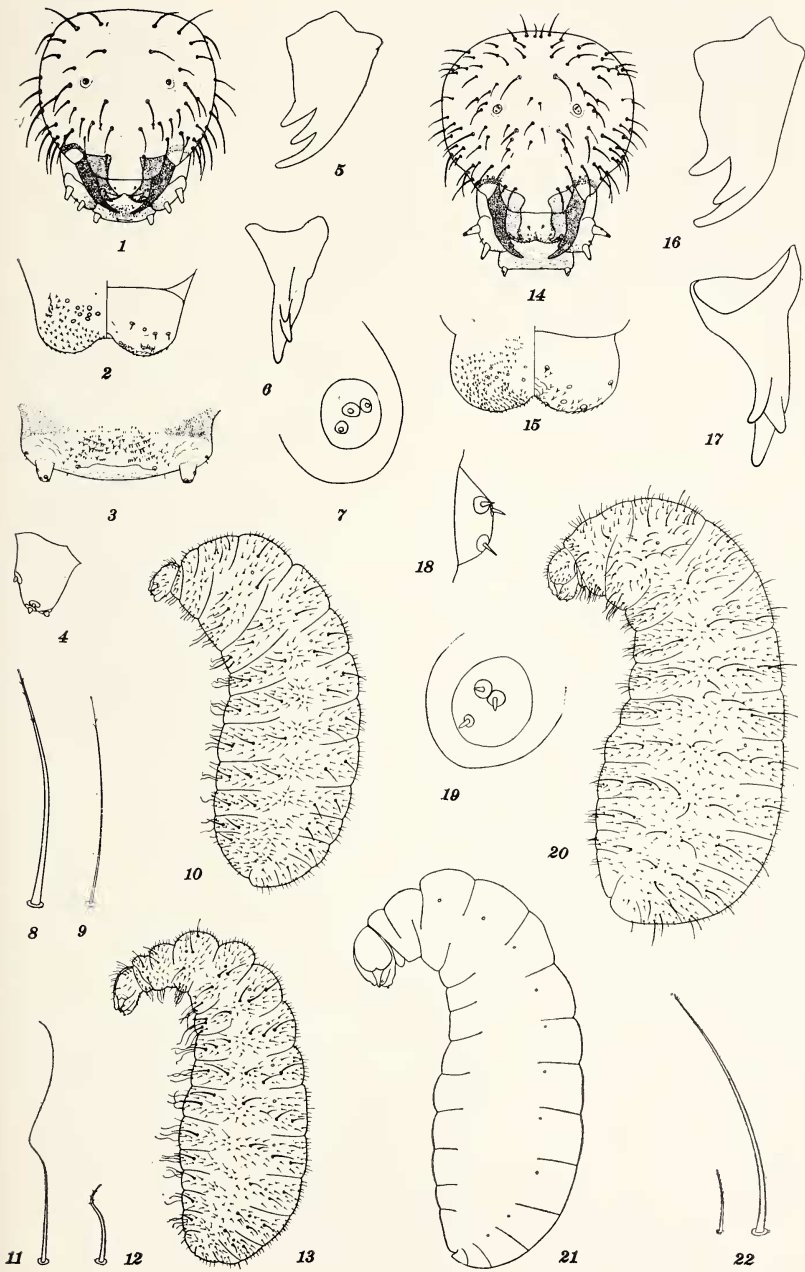
Wheeler, 1910: Fig. 42 on p. 76 repeats 1900, fig. 9; Fig. 36 on p. 70, photograph of five larvae. "The larvae, as in *E. imberbiculus*, are fed with pieces of crushed or broken seeds. In my artificial nests these pieces were coated with saliva by the workers before being administered to the brood, a precaution which may insure the conversion of starch into sugar and facilitate its assimilation by the larvae" (pp. 290-291).

Wildermuth and Davis, 1931: The larvae are "cream

EXPLANATION OF PLATE 11

Pogonomyrmex occidentalis (Cresson), Figs. 1-13,—1, head in anterior view, X44; 2, labrum (left half of drawing shows posterior view, right half, anterior view) X118; 3, labium in anterior view, X118; 4, right labial palp in anterior view, X340; 5, left mandible in anterior view, X118; 6, left mandible in medial view, X118; 7, left antenna in anterior view, X340; 8 and 9, two long denticulate body hairs, X95; 10, mature larva in side view, X10; 11, simple body hair, X95; 12, short denticulate body hair, X95; 13, submature larva, X10.

Pogonomyrmex barbatus (F. Smith), Figs. 14-22.—14, head in anterior view, X44; 15, labrum (left half of drawing shows posterior view, right half, anterior view) X118; 16, left mandible in anterior view, X118; 17, left mandible in medial view, X118; 18, right antenna in lateral view, X340; 19, right antenna in anterior view, X340; 20, mature larva in side view, X10; 21, submature larva in side view (hairs omitted), X10; 22, two body hairs, X95.



colored and are shaped like crooknecked squashes, the smaller crooked portion ending in a very small head. The length of the full-grown larva, not including the portion turned back is about one-fourth of an inch" (p. 3). Fig. 1D, larva in side view.

Pogonomyrmex occidentalis (Cresson)

(Pl. 11, figs. 1-13)

Stout; diameter nearly uniform throughout but with the thorax somewhat attenuated and bent ventrally; no neck; posterior end broadly rounded. Anus terminal. Leg, wing and gonopod vestiges present. Nine differentiated somites. Body hairs moderately numerous, uniformly distributed. Of three types: (1) short (0.036-0.08 mm), with the distal half finely denticulate and the base stout to slender, uniformly distributed; (2) long (about 0.27 mm) hairs with the distal half finely denticulate; a few in a single row around the middle of each somite and also on the venter of the prothorax and of the last abdominal somite; (3) smooth and long (0.18-0.35 mm), with slender base and long flexible tip, restricted to the ventral surface. Cranium transversely subelliptical, somewhat broader than long. Antennae small slightly raised discs, each with three sensilla, each of which bears a short stout spinule. Head hairs moderately numerous, short, to long (0.045-0.11 mm), sparsely denticulate on the distal half. Labrum small and short (breadth 2X length), bilobed, somewhat narrowed ventrally; anterior surface of each lobe with three minute hairs, an isolated sensillum near the middle and a pair of contiguous sensilla near the ventral border; ventral border of each lobe with spinules and a pair of contiguous sensilla; posterior surface of each lobe with three or four isolated and one or two sets of two or three sensilla each and a few coarse and mostly isolated spinules. Mandibles robust, heavily sclerotized; apical tooth long, tapering only slightly to a rounded point; the two medial teeth are shorter but still quite long, subequal and round-pointed. Maxillae with the apex paraboloidal and spinulose, the spinules coarse and isolated; palp paxilliform with two apical, two sub-apical and one lateral sensilla; galea paxilliform, shorter than palp, with two apical sensilla. Labium with the

anterior surface moderately spinulose, the spinules minute and isolated or in short transverse rows; palp a stout subcone bearing three apical and one lateral sensilla; opening of sericteries a short transverse slit (concealed in a groove).

SUBMATURE: Shaped somewhat like a crookneck squash, the thorax forming a moderately slender neck which is strongly arched ventrally, the abdomen elongate, subellipsoidal and moderately stout; posterior end narrowly rounded. Anus subterminal. Otherwise as in the mature larva.

(Material studied: numerous larvae from North Dakota.)

Pogonomyrmex (Ephobomyrmex) imberbiculus Wheeler

Wheeler, 1902, p. 90: House flies were "cut into pieces and fed to the larvae in the same manner as I have described for the Ponerinae and some Myrmicinae. On one occasion nearly every larva in the nest could be seen munching a small piece of house fly. But a still more remarkable method of feeding was adopted after a few days, when the supply of insect food was exhausted. Then the ants were seen to bring seeds from their granary, crack them open with their strong mandibles, and, after consuming some of the softer portions themselves, to distribute the remainder among their larvae. The latter could be seen under the lens cutting away with their mandibles and devouring the softer starchy portions of the seeds . . . These observations show that *the larvae of certain ants are not only able to subsist on solid food, but even on food of a vegetable nature.* The adaption of what were probably once exclusively carnivorous ants to a vegetable diet, although not yet complete, is, nevertheless, so far advanced that the larva already participates in the peculiar feeding habits of the adult insect. The *P. imberbiculus* seem not to possess the power of feeding one another or their larvae by regurgitation. At any rate they were not seen to make use of this method in the artificial nests." (Brief mention by Wheeler, 1910, p. 284 and 1933, p. 15 and by Wheeler and Bailey, 1920, p. 251.)

Pogonomyrmex (Ephobomyrmex) naegelii Forel

Eidmann, 1936, p. 39: "Die spärlich beborsteten Larven

zeigen ebenso wie die nackten Puppen keine bemerkenswerten Besonderheiten."

Pogonomyrmex (Forelomyrmex) mayri Forel

Apparently similar to *occidentalis* except for the following characters: Head oval in anterior view, somewhat longer than broad. Head hairs few. Anterior surface of each lobe of labrum with two minute hairs and four sensilla; posterior surface with five scattered sensilla on each lobe. Mandibles larger and more elongate, the medial teeth more blade-like. Labial palp with four apical and one lateral sensilla. (Material studied: three integuments (without hairs) from Colombia.)

Genus *Myrmica* (Latreille)

Stout; diameter greatest at the fifth abdominal somite; slightly attenuated anteriorly; thorax very stout and arched ventrally, but not differentiated into a neck; posterior end broadly rounded; anus posteroventral. Body hairs sparse; minute to long, of three types — (1) simple, (2) denticulate and (3) anchor-tipped; anchor-tipped hairs in transverse rows of 2-4, restricted to the dorsal surface of the 5-8 anterior abdominal somites, one row on each somite. Antennae each with three (rarely two or four) sensilla, each bearing a stout spinule. Head hairs few, short to long, mostly denticulate. Labrum small and short, breadth twice the length; bilobed; anterior surface of each lobe with 2-4 minute hairs and usually one or two sensilla; ventral border of each lobe with two sets of two contiguous sensilla each; posterior surface with minute spinules arranged in rows and with 8-18 sensilla. Mandibles with the apical third stout, sharp-pointed and slightly curved medially; anterior surface produced mesally into a thin blade, which usually bears one small stout tooth and which may be denticulate near the base; mesal surface concave.

Adlerz, 1886: "Some larvae with hairs shorter and simple or moderately branched at the tip, some with longer hairs which are either provided with short lateral spines or are shortly branched at the tip. The tips of the uncinat hairs vary but the anchor-like shape is the most common" (p. 259; translated from Swedish by Professor Edith E.

Larson). Transitional types occur (p. 258). Pl. 7, fig. 6, four hair tips. Internal anatomy, p. 58.

Donisthorpe, 1915, p. 109: "Yellow, narrow anteriorly, broad posteriorly; the segments gradually increasing in width until quite close to the base. The whole body covered with hairs, which are much more abundant in the young larvae. The first to the sixth abdominal segments are furnished on the dorsum with a pair of long anchor-tipped hairs, which are generally absent in the full-grown larvae. Some of the other long hairs possess a single hook instead of an anchor-tip, some hairs are serrate, and some bifurcate or trifurcate." (Repeated 1927*a*, p. 117.) Fig. 44 on p. 32 in both editions: Two hairs "on *Myrmica* larva".

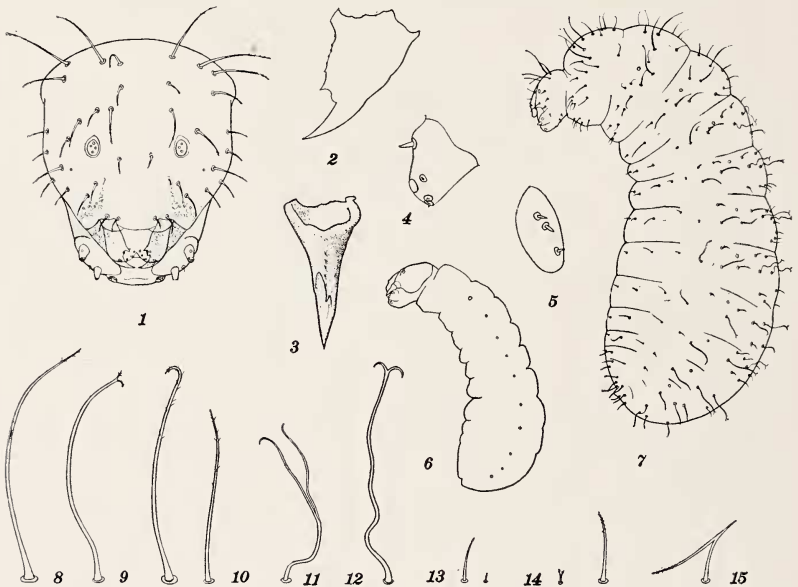
Donisthorpe, 1927*b*: Staphylinid beetles of the genus *Atemeles* prey upon the larvae of *Myrmica* (p. 17). Staphylinid beetles of the genus *Lamprinus* and their larvae devour *Myrmica* larvae (p. 72).

Janet, 1904, pp. 31-32: "Quant aux petites larves, elles s'accrochent les unes aux autres par des poils spéciaux. Chez la *Myrmica*, et chez bon nombre d'autres Myrmicidae, cet accrochage se fait par de longs poils terminés par des crochets simples ou double. Ces poils sont disposés régulièrement en petit nombre sur chaque anneau. Les nouveaux poils, formés à la suite d'une mue, ne sont pas exactement semblable à ceux de la cuticule exuviée."

Stärcke, 1948, pp. 26 and 28: "The ordinary hookform with the head bent perpendicularly to the body or even a little further, the thoracal segments ranged fan-like, the abdomen next without any special demarcation, straight, and only the extremity a little swollen, with some whitish spots of urate cells shining through. Usually the head is for one third sunk into the prothorax. With the fullgrown larva, the head grows still more into the prothoracical segment, until more than half its volume is situated there . . . There are 13 postcephalic segments of which the last 3 or 4 are not clearly marked. Newly emerged larvae are portly and hooklike from the start . . . The head, of a 3 mm larva is 0.42 mm long and at the rear end 0.36 mm broad, the mouth parts are 0.24 mm broad. The most protruding part is the distal sensilla-turret of the maxilla, but the labrum and mandibula do not stay back very far."

Myrmica emeryana Forel
(Text fig. 1, figs. 1-3 and 6-15)

Stout; diameter greatest at the fifth abdominal somite, slightly attenuated anteriorly; thorax very stout and arched ventrally but not differentiated into a neck; posterior end broadly rounded. Anus posteroventral. Leg, wing and gonopod vestiges present. Eleven differentiated somites. Integument spinulose on the dorsal surface of the posterior somites and on the ventral surface of the mesothorax, metathorax and first few abdominal somites; the spinules sparse and minute, isolated or in short transverse rows.



Text figure 1. *Myrmica emeryana* Forel, Figs. 1-3 and 6-15.—1, head in anterior view, X67; 2, left mandible in anterior view, X185; 3, left mandible in medial view, X185; 6, very young larva in side view (hairs omitted), X20; 7, mature larva in side view, X20; 8-10, four long denticulate body hairs, X121; 11, an atypical body hair, X121; 12, anchor-tipped body hair, X121; 13, two simple body hairs, X121; 14, two small denticulate body hairs, X121; 15, and atypical denticulate body hair, X121.

Myrmica monticola Wheeler, Figs. 4-5.—4, left maxillary palp in lateral view, X340; 5, right antenna in lateral view, X340.

Body hairs sparse, somewhat sparser on the ventral surface of the abdomen, minute to long. Of three types: (1) simple, minute to short (0.003-0.054 mm), generally distributed; (2) denticulate, minute to long (0.012-0.28 mm), the most abundant type, (3) anchor-tipped, long (about 0.28 mm), with the shaft flexuous, four in a row across the dorsal surface of each abdominal somite I-VIII. The denticulate hairs are extremely variable, the denticles may be few to numerous, limited to the tip or extending halfway to the base, closely applied to the shaft or suberect, the tip may be nearly straight, strongly curled or bifid. Only simple hairs are found on the ventral surface. Cranium as broad as long, broadest at the dorsal corners which bulge laterally, occipital outline rounded. Antennae with three (rarely four) spinulose sensilla each. Head hairs few, short to long, longest near the occipital border. Of two types: (1) denticulate, 0.05-0.21 mm; (2) simple, 0.035-0.07 mm. Labrum small, short (breadth 2X the length), bilobed, somewhat narrowed ventrally; anterior surface of each lobe with three or four minute hairs and a sensillum; ventral border with two sets of two contiguous sensilla each; posterior surface of each lobe with a central spinulose area, the spinules minute and in short transverse rows; six or seven scattered sensilla on the posterior surface of each lobe. Mandibles rather small and heavily sclerotized; distal third forming a stout, sharp-pointed apical tooth which is curved medially and which has a concavity on its mesal surface; anterior surface produced medially into a narrow blade, the edge of the blade variable but usually with one small, stout tooth near the base of the apical tooth and with a few denticles on the proximal half. Maxillae with the apex paraboloidal; palp a skewed peg with two apical, two subapical and one lateral sensilla; galea a frustum with two apical sensilla. Labial palp a low rounded elevation with five sensilla; opening of sericteries a short transverse slit (concealed in a groove). Hypopharynx with a very few rows of minute spinules. (Material studied: numerous larvae from Massachusetts, Michigan and North Dakota.)

YOUNG: Length 2 mm. Similar to the mature larva except in the following details: Body curved ventrally. Anchor-

tipped hairs may occur on the mesothorax and metathorax (2-4 on each) and the long denticulate hairs on the lateral surfaces of the mature larvae may be replaced by anchor-tipped hairs to a total of eight per somite. No spinules on the ventral surface.

Myrmica americana Weber

Similar to *emeryana* except in the following details: Hairs about twice as numerous on the thorax and four times as numerous on the abdomen. Anchor-tipped hairs usually reduced to two per somite and restricted to abdominal somites I-V, even some of these may be replaced by hairs with bifid denticulate tips. Posterior surface of labrum more generally spinulose; posterior surface of each lobe with five isolated and a cluster of two to four agglomerated sensilla. Mandibles with the apical tooth more slender and the mesal border serrate. Labium with anterior surface sparsely spinulose, the spinules minute and in short transverse rows. Hypopharynx sparsely spinulose, the spinules minute and in widely spaced transverse rows. (Material studied: numerous larvae from North Dakota.)

Tanquary, 1913, Pl. LXIV, fig. 36: an embryo just before hatching. The ant was called *M. sabuleti*.

Myrmica brevinodis Emery

Similar to *emeryana* except in the following details: Simple body hairs attain a much greater length (0.009-0.25 mm), the denticulate hairs are not so short (0.072-0.25 mm), anchor-tipped hairs only two per somite. Posterior surface of labrum sparsely spinulose throughout, the spinules minute and in short transverse row basally, while the distal rows become arcuate and form a reticulate pattern; the posterior surface of each half with two isolated and two agglomerated sensilla. Apical tooth of mandible sharper and more curved medially. Labium with the anterior surface spinulose, the spinules in short transverse rows. Hypopharynx sparsely spinulose, the spinules minute and in a few short transverse rows.

Male larva similar to worker larva but larger.

(Material studied: numerous larvae from Connecticut and North Dakota.)

Wheeler (1907) stated that the larvae and immature pupae of var. *sulcinodoides* Emery had a peculiar greenish yellow color and oily luster, which he had not observed in any of the other varieties (p. 75). The larvae and young pupae of var. *canadensis* Wheeler were pearly white (p. 77).

Myrmica brevispinosa Wheeler

Similar to *emeryana* except in the following details: Simple body hairs all minute (about 0.003 mm); anchor-tipped hairs reduced to two per somite and restricted to abdominal somites I-VI. Head with the genal borders nearly straight. Posterior surface of labrum completely but sparsely spinulose, the spinules longer than in *emeryana* and in longer rows; each lobe with two to three isolated and a cluster of two or three contiguous sensilla. Anterior surface of labium with numerous short arcuate rows of minute spinules. Hypopharynx with minute spinules in moderately long subtransverse rows. (Material studied: two larvae and one semipupa from North Dakota.)

Myrmica lobicornis fracticornis Emery

Similar to *emeryana* except in the following details: Simple body hairs shorter (0.003-0.036 mm); denticulate hairs longer (0.045-0.32 mm); anchor-tipped hairs shorter (0.21 mm), restricted to the dorsal surface of abdominal somites I-VII. The cranium lacks the dorsolateral bulges. Posterior surface of labrum more generally spinulose; posterior surface of each lobe with four isolated and one set of two contiguous sensilla. (Material studied: a dozen larvae from North Dakota.)

Myrmica monticola Wheeler

(Text fig. 1, figs. 4-5)

Similar to *emeryana* except in the following details: Abdominal hairs twice as numerous. Denticulate hairs 0.036-0.18 mm long; anchor-tipped hairs shorter (0.18 mm) and restricted to abdominal somites I-V. Head hairs all denticulate. Labrum narrowed dorsally; posterior surface sparsely spinulose, the spinules minute and in subtransverse rows. Mandibles without denticles on the proximal half of the mesal border. Apex of maxillae sparsely spinu-

lose, the spinules isolated and rather coarse. Anterior surface of the labium with a few minute spinules in short transverse rows. Hypopharynx sparsely spinulose, the spinules minute and in short transverse rows. (Material studied: numerous larvae from North Dakota)

Myrmica rubra (Linnaeus)

Adlerz (1886, p. 52) stated that overwintering larvae were remarkably hairy. (Referred to as *ruginodis*.)

Donisthorpe, 1915 (=1927), Pl. I: an excellent photograph of a larva in side view. (Referred to as *ruginodis*.)

Gösswald (1934/35, p. 125) has recorded this species as a mermithid host; presumably the nematode larvae had been parasitic in the ant larvae. (Referred to as *ruginodis*.)

Hagmeier (1912, p. 529) reported the larvae of the nematode *Mermis brevis* Hagmeier in the larvae of this ant.

Janet, 1904, Fig. 11 on p. 32: hairs. The one-hooked hair is refigured by Escherich 1906, Fig. 32 (=1917, Fig. 38B).

Latreille, 1802, p. 7: "La larve ressemble à un petit ver sans pied, dont le corps est composé de douze anneaux, et dont la tête est ordinairement penchée vers la poitrine."

Lubbock (1882, p. 7) observed a larval period of less than a month. (Mentioned by Adlerz, 1886, p. 53) (Referred to as *ruginodis*.)

Schwammerdam, 1693, Pl. IX: Fig. III shows a larva (probably *rubra*) in ventral view; Fig. IV, in side view.

Stärke (1948, p. 29) compared this larva with that of *M. schencki*: "Oncochaetae occur on Th. II and Th. III also, and on 7 abdominal segments, and they are longer, with 3 larvae 222 Micron was found. The Acrochaeta measures 91 to 128 Micron, exceptionally 164 (length of larva 1.57 mm, head 0.38 mm)." (Referred to as *ruginodis*.)

Myrmica rubra laevinodis Nylander

Similar to *emeryana* except in the following details: Anchor-tipped body hairs restricted to the dorsal surface of abdominal somites I-VI. Head hairs shorter (0.009-0.13 mm). Labrum narrowed dorsally; anterior surface of each lobe with two minute hairs and one or two isolated sensilla; posterior surface of each lobe with one or two

sets of two or three contiguous sensilla and two or three isolated sensilla; the whole posterior surface sparsely spinulose, the spinules minute and in subtransverse rows. Hypopharynx sparsely spinulose, the spinules minute and in short subtransverse rows. (Material studied: numerous larvae from Massachusetts.)

DeGeer, 1778, Pl. XLIII: Fig. 7, larva in side view; Fig. 8, head showing antennae ("yeux"), mandibles ("dents") and maxillary palp and galea ("barbillons"). Probably *laevinodis*.

Donisthorpe, 1927*b*, pp. 116 and 118: The caterpillars of *Lycaena arion* L. pass the winter in the nests of this ant and devour its larvae.

Eidmann, 1943, p. 224: This species overwinters with larvae.

Gösswald (1934/35, p. 125) reported this species as a host of mermithids. Presumably the nematode larvae were parasitic in the ant larvae.

Myrmica sabuleti Meinert

Chapman (1915/16): See under *scabrinodis*.

Stärcke, 1948, p. 29: The larva of this species "does not show any perceptible difference as to hairs with that of *M. schencki*". Figs. 20, 22, 24, 33 and 34.

Myrmica scabrinodis Nylander

Chapman (1915/16) found that the larvae of *M. scabrinodis* var. *sabuleti* were preyed upon by the caterpillars of *Lycaena arion* L. Plates XL, XLI, XLVII, XLVIII and XLIX are photomicrographs which show fragments of ant larvae in the feces of the caterpillar. Donisthorpe (1927*b*, pp. 116 and 118) and Wheeler (1928, p. 260 = 1926, p. 313), in discussing this relationship, refer to the ant as *M. scabrinodis*.

Donisthorpe, 1915 (=1927) Fig. 43 on p. 31: Part of the larval head. This figure is inaccurate in that the labium and antennae are shown on the same surface of the head.

Eidmann, 1943, p. 226: Larvae overwinter in the nest.

Gösswald (1934/35, p. 125) has listed this ant as a mermithid host. Presumably the nematode larvae were parasitic in the ant larvae.

Myrmica schencki Emery

Gösswald (1934/35, p. 125) has listed this ant as a mermithid host. Presumably the nematode larvae were parasitic in the ant larvae.

Stärcke, 1948: "Hairs. These are of three types. 1. ACROCHAETAE, straight or only slightly curved, pointed. Looked at through the immersion lens they appear to be armed with a number of very short and small thorns. Length 164-183 Micron, exceptionally up to 219 Micron. 2. MICROCHAETAE. Just the same, but shorter, 73-128 Micron, occasionally even shorter still. 3. ONCOCHAETAE (WHEELER; APTOCHETE MENOZZI 1936), simple and flexible, not pointed but tipped with double hooks in the shape of an anchor. Length 164-201 Micron. With the living larva or the larva kept in formaline they are straight, but as most investigators keep their larvae in alcohol, in which the oncochaetae shrink and become flexuous, they have been pictured that way by most authors and so I did the same. Each segment bears a transversal row of Acrochaetae, numbering five on both sides of the thorax, and two or three less regular rows of Microchaetae. The ventral side of the abdominal segments does not wear hairs, except for the last segments and even there they are very rare. On the ventral side of the prothorax there is also this row of Acrochaetae and some less regularly placed Microchaetae, but they are shorter than anywhere else. The mesothoracal and metathoracal segments have only one irregular row of Microchaetae each on their ventral side. Dorsally and on the sides these segments possess from 6 to 10 Acrochaetae; the two or three irregular rows of Microchaetae are diffused ventrally into one transversal row of short hairs. The function of these hairs on the ventral side of the thorax may be to form a kind of trophothylax or food-bag, preventing the pieces of insects laid down there by the workers from slipping off, so the larva can grasp them with her mandibles. On the ventral side the first 6 abdominal segments are completely bald. Dorsally the row of Acrochaetae is replaced by a row of Oncochaetae, which reaches till halfway down the sides. Further down on the ventral half of the sides — but not on the ventral side itself — these On-

cochaetae are again replaced by Acrochaetae with this peculiarity however that they have their ends cleft into two or four ramifications (only discernible with the use of the immersionlens) or even somewhat plumose. With the younger stages of the larva the Oncochaetae occur on the first 5 abdominal segments, with the full-grown larva only on the first 3. Occasionally they occur on 4 or 6 segments but never on 7 as is the case with *M. ruginodis*. The number of hairs can only vary after moulting, so that if small and hungry larvae look more hairy than well-fed ones there is still no real difference. Their distance from each other is somewhat less than their length; the Oncochaetae f.i. are implanted circa 120 Micron one from the other in each row. The anchor-shaped hooks have a width of 22 to 55 Micron, according to the point of observation. The last 3 abdominal segments look hairy on all sides like the prothorax, but only apparently so, as these segments are curved towards the ventral side, the caudal end of the body being formed by the dorsal face of the last 2 or 3 abdominal segments and the proctodaeum opening on the ventral side. Orally from it there are no hairs or at least very few on the ventral side of the abdomen. The transversal rows are less regular. On the head there are only hairs of the smaller type; 3 on each side along the occiput, an irregular row of 4 longitudinally near the coronal suture, a row of 4 in zigzag formation slanting obliquely from the mandibula to the back of the head, a row of 4 small ones on the cheek slating upwards to the back of the head, and 2 on each side of the clypeus" (pp. 28-29).

"The *Mandibulae*, the most sklerotized parts, internally coated with epithelium and in the centre with tracheal and nervous tissue, both up to the point where the teeth begin. A mandibula consists of a vertical elongated triangular plate, connected with the frenum and on which the muscles are inserted, and a medial plate joined perpendicularly, that gradually merges into the vertical plate and bears the teeth, an awl-shaped apical one, two large incisive teeth and several ranges of pointed tubercles that are suitably adapted to serving as molar teeth. . . The *Sensilla turrets* of the *Maxilla* are often indicated as larval palps, and so are the sensilla turrets of the *Labium*. The maxilla

possesses two of them, usually one, somewhat broader, lateral or proximal one and one, slenderer, medial or distal one; the former is according to the authors a homologon of the adult maxillary palp, the latter of the galea etc. of the adult insect. The much lower *turrets* of the *Labium*, one pair, situated somewhat laterally and distally of the orificium of the labial gland on the premental part, are designed as labial palps of the larva. Both wear entrenched short conical sense-hairs, which apparently have a taste function and are connected with special nervestems and ganglia belonging to the gnathal brainganglion. More sensilla of this kind and also of the type sensilla basiconica, but somewhat taller and thicker-skinned, are dispersed over the labrum, the maxilla and the labium. . . The *Antennal plate*, a slightly convex oval plate of thickened cuticula, partly covering the discus antennae. Excentrically it bears a still more thickened plate with three sensilla of the typus s. basiconica. This number is constant with all the ant larvae I examined. Only once I saw a *schencki* larva with 4 sensilla on it. . . The antennal plate of the *schencki* larva is 36 Micron in length and 30 wide; the yellowish sklerotized central part measures 18 Micron (unstained total pr.), 18 Micron by 14 (KOH - ac. fuchsin). Proximal maxillary turret high 22, broad 20 Micron; distal (medial) turret high 31, broad 20 Micr. The shape and dimensions of the turrets have systematical value. Myrmicine larvae have no spinnerets" (pp. 34-35). "The orificium is shaped like a horse-shoe and is situated on the dorsal 1/3 of the labium, without any spinneret in *Myrmica*." (p. 47). "The egg stage lasts (at 68-80 degrees F.) about 4 weeks, the larval stage 3 to 5 weeks if well-fed, but much longer — up to 6 months — if insufficiently fed, the praenymphal stage 6 to 7 days and the nymphal stage 7 to 14 days. The egg, the newly emerged larva and the nymph require a higher temperature than the majority of the larvae and are usually carried off to drier places" (p. 39). "The hatching of the larva from the egg progresses as follows. At the posterior or caudal end the embryo separates itself from the egg-shell. Then the cuticula of the oral third of the egg detaches itself like the lifting of a lid and the anterior part of the larva issues gradually. This larva I does not yet

show any hairs. She grows rapidly under the care of the workers and soon attains a length of about 1,2 mm. In the period between attaining this length and that of 2 mm there occurs a moulting, which begins at the margins of the segments. The hairs that appear first are those which fringe the back of the head. A few hours later the hairs on the dorsal face of the thorax follow and after these gradually the other ones. The erecting hairs lift the skin which then cleaves and is licked off by the workers. . . This first moulting happens on the second or third day, occasionally already on the first. The larva II attains a length of 2,28 mm. Between this length and 2,37 mm there must occur a second moulting" (p. 37). "Spontaneous movement and position-reflexes of the larva," pp. 63-64. Table on p. 37: age, length of head, length of larva, head hairs. Table on p. 38: length of male larvae, length of hairs. Figs. 2-4, 9-21, 29 and 33-36 depict wholly or chiefly external anatomy; the remaining figures and most of the text treat internal anatomy and histology.

Myrmica smythiesi dshungarica Ruzsky

Similar to *emeryana* except in the following details: Simple body hairs longer (0.009-0.09 mm); anchor-tipped hairs shorter (about 0.18 mm). Head hairs shorter (0.045-0.1 mm). Labrum narrowed dorsally; anterior surface of each lobe with two or three minute hairs and one or two isolated sensilla; posterior surface with four to six isolated and a cluster of two or three contiguous sensilla; the whole posterior surface sparsely spinulose, the spinules longer and in short subtransverse rows. Hypopharynx sparsely spinulose, the spinules longer and in moderately long subtransverse rows. (Material studied: six larvae from Siberia).

Genus *Manica* Jurine

Manica rubida (Latreille)

Forel, 1874, p. 388 = 1920. p. 265: Les larves "sont rondes et épaisses en arrière, longues et effilées en avant, également arquées d'avant en arrière."

A BIBLIOGRAPHY OF THE LARVAE OF THE TRIBE MYRMICINI

ADLERZ, G.

1886. Myrmecologiska Studier II. Svenska Myror och deras Lefnadsförhållanden. Behang till K. Svenska Vet.-Akad. Handl., 11:1-329, 7 pls.

CHAPMAN, T. A.

- 1915/16. What the larva of *Lycaena arion* does during its last instar. Observations completing an outline of the life history of *Lycaena arion*, L. Trans. Entom. Soc. London, 291-297, 9 pls.; 298-312, 3 pls.

DE GEER, K.

1778. Mémoires pour servir à l'histoire des insectes 7.

DONISTHORPE, H.

1915. British ants, their life-history and classification. xv + 379 pp., 18 pls., 92 text figs. Plymouth: Wm. Brendon and Son, Ltd.
- 1927a. British ants, their life-history and classification. 2 ed. xv + 436 pp., 18 pls., 93 text figs. London: George Routledge and Sons, Ltd.
- 1927b. The guests of British ants, their habits and life-histories. xxiii + 244 pp., 16 pls., 55 text figs. London: George Routledge and Sons, Ltd.

EIDMANN, H.

1936. Oekologisch-faunistische Studien an südbrasilianischen Ameisen. Arb. Phys. Angew. Entom. Berlin-Dahlem, 3: 26-48, 81-114, 1 pl., 5 text figs.
1943. Die Ueberwinterung der Ameisen. Zeitschr. Morph. Oekol. Tiere, 39: 217-275, 14 figs.

ESCHERICH, K.

1906. Die Ameise. Schilderung ihrer Lebensweise. xx + 232 pp., 68 figs. Braunschweig: Friedr. Vieweg und Sohn.
1917. Die Ameise. 2 ed. xvi + 348 pp., 98 figs. Braunschweig: Friedr. Vieweg und Sohn.

FOREL, A.

1874. Les fourmis de la Suisse. Nouv. Mém. Soc. Helv. Sc. Nat. Zurich, 26: 447 pp., 2 pls
1920. Les fourmis de la Suisse. 2 ed. La Chaux-de-Fond: Le Flambeau. 333 pp., 49 figs.
1921. Le monde social des fourmis du globe comparé à celui de l'homme. Tome I. xiv + 192 pp., 1 pl., 2 col. pls., 30 text figs. Genève: Librairie Kundig.
1928. The social world of ants compared with that of men. Translated by C. K. Ogden. 2 vol. 551 + 445 pp., 24 pls. (8 col.), 138 text figs. London and New York: G. P. Putnam's Sons, Ltd.

GÖSSWALD, K.

- 1934/35. Ueber Ameisengäste und -schmarotzer des mittleren Main-

gebiets. Entom. Zeitschr., 48: 119-120, 125-127, 133-134, 142-143, 165-167, 175-176, 181-182, 13-15.

HAGMEIER, A.

1912. Beiträge zur Kenntnis der Mermithiden. I. Biologische Notizen und systematische Beschreibung einiger alter und neuer Arten. Zool. Jahrb., Abt. Syst., 32: 521-612, 5 pls., 7 text figs.

JANET, C.

1904. Observations sur les fourmis. 68 pp., 7 pls., 11 text figs. Limoges: Ducourtioux et Gout.

LATREILLE, P. A.

1802. Histoire naturelle des fourmis. Paris An, 10, 1 vol.

LUBBOCK, J.

1882. Ants, bees, and wasps. xix + 448 pp., 5 col. pls., 31 text figs. New York: D. Appleton and Co.

STÄRCKE, AUG.

1948 (1949). Contribution to the biology of *Myrmica schencki* Em. Tijdschr. Entom., 91: 25-71, 50 figs.

SWAMMERDAM, J.

1693. Historia insectorum generalis.

TANQUARY, M. C.

1913. Biological and embryological studies on Formicidae. Bull. Illinois State Lab. Nat. Hist., 9: 417-479, 8 pls.

WHEELER, W. M.

1900. A study of some Texan Ponerinae. Biol. Bull., 2: 1-31, 10 figs.

1902. A new agricultural ant from Texas, with remarks on the known North-American species. Amer. Nat., 36: 85-100, 8 fig.

1907. Notes on a new guest-ant, *Leptothorax glacialis*, and the varieties of *Myrmica brevinodis* Emery. Bull. Wisconsin Nat. Hist. Soc., 5: 70-83.

1910. Ants, their structure, development and behavior. xxv + 663 pp., 286 figs. New York: Columbia University Press.

1926. Les sociétés d'insectes: leur origine — leur évolution. xii + 468 pp., 61 figs. Paris: Gaston Doin et Cie.

1928. The social insects, their origin and evolution. xviii + 378 pp., 79 figs. New York: Harcourt, Brace and Co.

1933. Colony-founding among ants, with an account of some primitive Australian species. x + 179 pp., 29 figs. Cambridge: Harvard University Press.

WHEELER, W. M., AND I. W. BAILEY

1920. The feeding habits of pseudomyrmine and other ants. Trans. Amer. Phil. Soc., (Art. 4): 235-279, 5 pls., 6 text figs.

WILDERMUTH, V. L., AND E. G. DAVIS

1931. The red harvester ant and how to subdue it. U. S. Dept. Agric. Farmers' Bull. No. 1668: 21 pp., 14 figs.